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10/597,085	07/11/2006	Franck Laffargue	FR040007	5848

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EXAMINER	
LIU, LI	

ART UNIT	PAPER NUMBER
2624	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/597,085	LAFFARGUE ET AL.	
	Examiner	Art Unit	
	LI LIU	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 July 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-14* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-14* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *11 July 2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Claim Objections

2. The numbering of claims is not in accordance with 37 CFR 1.126 which requires the original numbering of the claims to be preserved throughout the prosecution. When claims are canceled, the remaining claims must not be renumbered. When new claims are presented, they must be numbered consecutively beginning with the number next following the highest numbered claims previously presented (whether entered or not).

Claim 14 is missing in originally filed claims.

Claim 15 is now renumbered by the Examiner as claim 14. Please refer to the new claim 14 in future correspondences.

3. Claim 12 is objected to because of the following informalities:

The ending of the sentence should be a period instead of semi-colon.

Specification

4. The disclosure is objected to because of the following informalities:

-- Page 3 line 12 recites "of a of a triangular face".

Claim Rejections - 35 USC § 101

5. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

6. Claim 14 is rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter as follows. Claim 14 defines a computer program product embodying functional descriptive material. However, the claim does not define a computer-readable medium or computer-readable memory and is thus non-statutory for that reason (i.e., 'When functional descriptive material is recorded on some computer-readable medium it becomes structurally and functionally interrelated to the medium and will be statutory in most cases since use of technology permits the function of the descriptive material to be realized" - Guidelines Annex IV). The scope of the presently claimed invention encompasses products that are not necessarily computer readable, and thus NOT able to impart any functionality of the recited program. The examiner suggests amending the claim(s) to embody the program on "computer-readable medium" or equivalent; assuming the specification does NOT define the computer readable medium as a "signal", "carrier wave", or "transmission medium" which are deemed non-statutory. Any amendment to the claim should be commensurate with its corresponding disclosure.

7. Claims 1-9 and 11 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter as follows. Claims 1-9 and 11 each recites the mere manipulation of data or an abstract idea, or merely solves a mathematical problem without a limitation to a practical application. A practical

application exists if the result of the claimed invention is "useful, concrete and tangible" (with the emphasis on "result")(Guidelines, section IV.C.2.b). A "useful" result is one that satisfied the utility requirement of section 101, a "concrete" result is one that is "repeatable" or "predictable", and a "tangible" result is one that is "real", or has "real-world" value, as opposed to being "abstract" (Guidelines, section IV.C.2.b). Claims 1-9 and 11 manipulate image data using deformable mesh model without ever producing a useful, concrete and tangible result.

It is the result that is the focus. If the result has a real world practical application/use, then the test has been satisfied. The claim need not include the uses to which the result is ultimately put, jest the result itself. Applicant is advised to provide a written explanation of how and why the claimed invention (either as currently recited or as amended) produces a useful, concrete and tangible result.

Claim Rejections - 35 USC § 112, second paragraph

8. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

9. Claims 1-14 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

--- Claim 1 (and by extension, all claims depending therefrom) is indefinite at least because claim 1 recites the limitation "adapting the size of the internal discrete elements". It is unclear what metrics are used to determine the size of the internal

discrete elements, is it edge lengths, boundary length, volume? Is it the size of each individual element, or the size of all elements together? The ordinarily skilled artisan would be unable to clearly delineate the metes and bounds of claim 1 because of the indefiniteness of the above limitation.

--- There are insufficient antecedent bases for the following limitations:

* Claim 1 recites "the local variation of size" in line 7.

* Claim 2 recites “the optimal size” in line 4

--- Claim 1 recites, *inter alia*, "an image processing system having image data processing means of segmentation of an object of interest ...". It is not clear from the claim language what structural elements of the image processing system have been configured to perform the claimed segmentation. Thus claim 1 is rendered indefinite for failing to particularly point out, with a reasonable degree of clarity, the structure of the image processing system that has been configured to perform the functional claim elements.

Dependant claims 2-9 and 11 do not cure the aforementioned indefiniteness deficiencies of claim 1 and so are similarly rejected for the reasons indicated above.

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

11. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

12. Claims 1-5, 7-8, and 10-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over George et al. (hereafter referred to as “George2002”, "An efficient algorithm for 3D adaptive meshing", ADVANCES IN ENGINEERING SOFTWARE, ELSEVIER SCIENCE, vol. 33, 2002, pages 377-387), in view of Failla et al. (hereafter referred to as “Failla”, US 2005/0143965).

Please note that the phrase "of segmentation of an object of interest" in Claim 1 is just an intended-use recitation and the required step to achieve the purposes is silent in the body of the claims. The phrase does not carry any patentable weight.

Regarding claim 1, George2002 discloses an unstructured deformable mesh model composed of surface discrete elements (**George2002, abstract, and page 378 right column describes the steps of generating a volume mesh: an empty mesh is first constructed. The empty mesh is a mesh whose vertices are the boundary points of a given domain**) and internal discrete elements (**George2002, page 378 right column, the step of internal point creation and insertion**), and further comprising means of refining the unstructured deformable mesh model by automatically dynamically adapting the size of the internal discrete elements (**the adaptive process of inserting internal points and mesh optimization**) according to the local variation of size of the surface discrete elements (**George2002, page 378 right column and page 379 left column, create new elements conforming to the size field of current mesh**).

George2002 does not specifically disclose segmentation of an object of interest using the mesh model in an image processing system.

Failla discloses a system for determine radiation doses delivered to specified volumes within human organs based on mesh models (Failla, pg. [0050]).

It would have been obvious to one of ordinary skill in the art at the time of the invention to apply George2002's mesh modeling method in medical field, for example for segmenting of an object of interest to determine radiation doses, as shown by Failla.

Regarding claim 2, George2002 in view of Failla discloses the image processing system of claim 1, further comprising image data processing means for acquiring size

information related to the surface discrete elements in order to evaluate the optimal size to be assigned to the internal discrete elements (**George2002, page 379 left column: the definition of the internal points is made with respect to the specified size field, and the specified size field may be known at the vertices of a background volume mesh**), and for propagating this size information from the surface discrete elements to the internal discrete elements while new internal discrete elements are created during the refinement process (**George2002, page 379 left column: iteration of constructing adapted mesh from the old mesh**).

Regarding claim 3, George2002 in view of Failla discloses the image processing system of claim 2, wherein new internal discrete elements are created during the refinement process by insertion of new vertices inside said internal discrete elements (**George2002, page 379 left column: iteration of constructing adapted mesh from the old mesh, and page 384, section 4.3 on point insertion**).

Regarding claim 4, George2002 in view of Failla discloses the image processing system of claim 3, comprising image data processing means to estimate mesh quality of the internal discrete elements and to refine the unstructured mesh model based on said estimated mesh quality (**George2002, page 385, section 4.4 on optimization processes: the mesh quality can be improved by two optimization processes**).

Regarding claim 5, George2002 in view of Failla discloses the image processing system of claim 4, wherein the unstructured mesh model is a 3D mesh model with surface discrete elements composed of triangles (T.sub.J), and internal discrete elements composed of tetrahedrons (TH.sub.J) (**George2002, abstract, and page 378 right column**); or the unstructured mesh model is a 2D mesh model with surface discrete elements composed of contour segments, and internal discrete elements composed of triangles (IT.sub.J).

Regarding claim 7, George2002 in view of Failla discloses the image processing system of claim 5, comprising: image data processing means to estimate a weight parameter (L.sub.J) assigned to each vertex of the discrete elements based on the average of the lengths of the edges joining said vertex to its neighbor vertices (**George2002, page 378 right column: "with each node of the boundary mesh, a size representing a mean of the adjacent edge lengths is associated"**); an optimal volume or surface associated to each internal discrete element (**George2002, page 379 left column: the definition of internal points is made with respect to the specified size field, and the iteration continues until it produces a mesh which is almost perfect in the size field**), the optimal internal discrete element shape being a regular tetrahedron or triangle and the real volume or surface of each initial internal discrete element (**George2002, page 378 right column**); and image data processing means for comparing the real volume or surface with respectively the optimal volume or surface and accordingly to initiate a refinement of an internal discrete element under study if the

real volume or surface of the internal discrete element is bigger than its optimal volume or surface (**George2002, page 378 right column, the stopping criterion of the iterative point insertion process depends only on the size field specified as input, which in effect reduces the real volume or surface of the internal element step by step until it reaches the optimal volume or surface, determined by the specified size field**).

Regarding claim 8, the combination of George2002 and Failla discloses the image processing system of claim 7, comprising image data processing means to estimate a validity criterion according to which a new internal element is valid if and only if its circum-sphere or circum-circle encloses no other vertex of the mesh (**George2002, abstract, page 378 right column, internal point insertion using the Delaunay kernel**).

Regarding claim 10, the combination of George2002 and Failla discloses the image processing system of claim 1, further comprising visualizing means for displaying processed images (**George2002, Figs. 3-8**).

Regarding claim 11, the combination of George2002 and Failla discloses the image processing system of claim 1, further comprising means for stopping the refinement of internal discrete elements when a predetermined threshold of mesh

quality is met (**George2002, page 379, left column, on stopping criterion of the adaptive process**).

Regarding claim 12, the combination of George2002 and Failla discloses a medical imaging system comprising a suitably programmed computer or a special purpose processor having circuit means, which are arranged to form an image processing system as claimed in claim 1 to process medical image data (**Failla, abstract, pg.[0005]**).

Regarding claim 13, the combination of George2002 and Failla discloses a medical examination imaging apparatus having: Means to acquire a three-dimensional image of an organ of a body; and a system according to claim 1 (**Failla, abstract, pg.[0005]**).

Regarding program claim 14, the limitations of the claim are rejected for the same reasons as set forth in the rejection of claim 1 above.

13. Claims 6 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over George2002 in view of Failla (US 2005/0143965), as applied to claim 5 above, and further in view of George et al. (hereafter referred to as “George1998”, "Delaunay Triangulation and Meshing", 1998, page 131-139 and 195-202).

Regarding claim 6, George2002 in view of Failla discloses the image processing system of claim 5, wherein, in 3D, the internal tetrahedrons (TH.sub.J) are initially constructed based on the vertices of the surface triangles and then refined by inserting vertices (**George2002, abstract, and page 378 right column describes the steps of generating a volume mesh**).

George2002 in view of Failla does not specifically disclose inserting vertices either at the middle of a tetrahedron edge; at the middle of a tetrahedron face; at the center of a tetrahedron; or at the center of the circum-sphere of a tetrahedron;

George1998 lists several methods of inserting internal points, Including centroid creation (weighted or not) for tetrahedral judged too large (**George1998, page 200**).

It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the teachings of George1998 with that of George2002 in view of Failla to yield the invention as described in claim 6, since inserting internal points at the center of an internal element's edge, surface, or volume would have been an obvious matter of design choice in the process of mesh refinement, as taught by George1998.

Regarding claim 9, George2002 in view of Failla discloses the image processing system of claim 7, wherein the image data processing means to estimate mesh quality of the internal discrete elements comprises a criterion based on the length of edges of the internal discrete elements (**George2002, page 385 section 4.4, edge length quality**) and a criterion based on the volume or surface of the internal discrete elements (**George2002, page 385 section 4.4, Element shape quality**).

George2002 in view of Failla does not specifically disclose using the diameter of its circum-sphere or circum-circle of the internal elements.

George1998 lists several methods of inserting internal points, Including "circumcenter creation for every tetrahedron that vialates certain criteria related to volume computation, inradius length, aspect ratio or quality, etc." (**George1998, page 200**).

It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the teachings of George1998 with that of George2002 in view of Failla to yield the invention as described in claim 9, since using length of edges, diameter of sphare, and volume value to estimate mesh quality would have been an obvious matter of design choice in the process of mesh refinement, as taught by George1998 and George2002.

Conclusion

14. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

LA Freitag, C Ollivier-Gooch, "A comparison of tetrahedral mesh improvement techniques", Fifth International Meshing Roundtable, 1996

Delingette, H., "Simplex meshes: a general representation for 3D shape reconstruction". IEEE Proceedings of Computer Vision and Pattern Recognition, 1994. pages: 856-859.

Yu, Huagang et al. (US 20040210429 A1): apparatus and methods for performing process simulation using a hybrid model.

Wan, Jun et al. (US 20050107994 A1): system, method, and computer program product for determining wall thickness in graphic model.

Van Rens; Bas Jan Emile (US 6781582 B1): mesh generator for and method of generating meshes in an extrusion process.

Taubin; Gabriel (US 6987511 B2): linear anisotrophic mesh filtering.

Miga; Michael I. et al. (US 7072705 B2): apparatus and methods of brain shift compensation and applications of the same.

Kraft, Joseph Anthony et al. (US 20020177985 A1): computer system and method for radial cooled bucket optimization.

Hoppe; Hugues H. (US 7280109 B2): regional progressive meshes.

Geng, Z. Jason (US 20050096515 A1): three-dimensional surface image guided adaptive therapy system.

Friedl; Christian et al. (US 6816820 B1): method and apparatus for modeling injection of a fluid in a mold cavity.

Dohrmann; Clark R. et al. (US 6560570 B1): method and apparatus for connecting finite element meshes and performing simulations therewith.

Chen, Xuesong et al. (US 20050018885 A1): system and method of anatomical modeling.

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to LI LIU whose telephone number is (571)270-5363. The

examiner can normally be reached on Monday-Thursday, 7:00AM-4:30PM, ALT. Fridays, EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Samir Ahmed, can be reached on (571)272-7413. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

L.L.

/Samir A. Ahmed/

Supervisory Patent Examiner, Art Unit 2624